



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/581,165	05/31/2006	Hee-Woo Rhee	930086-2027	1364

7590 12/17/2008
Ronald R. Santucci
Frommer Lawrence & Haug
745 Fifth Avenue
New York, NY 10151

EXAMINER

OJURONGBE, OLATUNDE S

ART UNIT	PAPER NUMBER
----------	--------------

1796

MAIL DATE	DELIVERY MODE
-----------	---------------

12/17/2008

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/581,165	Applicant(s) RHEE ET AL.	
	Examiner OLATUNDE S. OJURONGBE	Art Unit 1796	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-12 is/are pending in the application.
 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-12 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|----------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. ____. |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>20060531</u> . | 6) <input type="checkbox"/> Other: ____. |

DETAILED ACTION

1. The entry KR 10-0424503 was lined out on the Information Disclosure Statement (IDS) filed on 05/31/2006 because no English Language translation of the abstract is on file, and nowhere in the present specification is the relation of KR 10-0424503 to the present invention explained.

Specification

2. The disclosure is objected to because of the following informalities:

Page 5, line 14 of the present specification recites $(\text{CH}_3\text{-SiO}_{1.5})_n$; there is no definition for the term n .

Appropriate correction is required.

Claim Objections

3. Claim 2 is objected to because of the following informalities:

Claim 2 recites “.....and alpha,(-bistrialkoxysilyl)alkane.” The closing bracket is omitted from the statement.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 3 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 3 recites “....wherein said polyalkyl silsesquioxane copolymer is a copolymer of methyltrimethoxysilane and (,-bistrimethoxysilylethane or a copolymer of methyltrimethoxysilane and (,-bistriethoxysilylethane.”; it is unclear what claim limitation the applicant tries to set. For the purpose of this office action, the language is interpreted as “....wherein said polyalkyl silsesquioxane copolymer is a copolymer of methyltrimethoxysilane and bistrimethoxysilylethane or a copolymer of methyltrimethoxysilane and bistrimethoxysilylethane.”

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein

Art Unit: 1796

were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. **Claims 1, 4-7 and 10- 12** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Yim et al (US 2003/0055134)**.

Regarding **claim 1**, Yim et al teaches thin films having very low dielectric constant ($k < 2.50$) formed from a composition comprising thermostable organic or inorganic matrix precursor and thermo-unstable cyclodextrin derivatives [0017]; said composition may be prepared by dissolving the thermo-stable matrix precursor and the cyclodextrin derivatives in an appropriate solvent, said solvent used in sufficient amount to coat a substrate fully with the two solid components [0055-0056]. Yim et al further teaches examples of the thermo-stable inorganic matrix precursor to include (1) silsesquioxane and (3) a silicate composition, wherein the constitution of $\text{RSiO}_{1.5}$ or R_2SiO is organically modified. Yim et al further teaches that the silsesquioxane derived from organic polysiloxane can be exemplified by alkyl silsesquioxane and copolymer of the alkyl silsesquioxane among other components [0018]. Yim et al further teaches the cyclodextrin derivatives having maximum radius of about 1.3-3 angstrom [0046] and specific examples of the cyclodextrin derivatives to include hexakis(2,3,6-tri-O-acetyl)-alpha-cyclodextrin [0049].

Art Unit: 1796

The thin films of Yim et al having very low dielectric constant serves as the ultra-low dielectric film of the instant claim.

The thermo-stable inorganic matrix precursor of Yim et al, that includes (1) silsesquioxane and (3) a silicate composition wherein the constitution of $\text{RSiO}_{1.5}$ or R_2SiO is organically modified serve as the poly alkyl silsesquioxane precursor of the instant claim; and the cyclodextrin derivatives, exemplified by hexakis(2,3,6-tri-O-acetyl)-alpha-cyclodextrin of Yim et al, serves as the acetylcyclodextrin nanoparticles template of the instant claim.

Though Yim et does not teach an ultra-low dielectric film prepared by coating with an organic-inorganic mixed solution containing in an organic solvent 40-70 vol% of a polyalkyl silsesquioxane precursor or its copolymer as the matrix and 30-60 vol% of acetylcyclodextrin nanoparticles as the template, Yim et al further teaches using the cyclodextrin derivative in an amount of .1 to 95 wt% based on total of the solid components [0056]; it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art (i.e. does not require undue experimentation). In view of the fact that the teachings in Yim et al. are directed to an extremely broad range of weight % which encompasses the claimed vol %, one having ordinary skill in the art would have been motivated to work within disclosed range during routine experimentation, thereby rendering obvious the selection of a vol% within the claimed range.

Though modified Yim et al does not teach "In an ultra-low dielectric film for a copper interconnect...", the examiner notes that this is an intended use limitation; statements in

Art Unit: 1796

the preamble reciting the purpose or intended use of the claimed invention which do not result in a structural difference between the claimed invention and the prior art do not limit the claim and do not distinguish over the prior art apparatus.

Moreover, “in an ultra-low dielectric film for a copper interconnect prepared using an organic or inorganic matrix and a cyclodextrin-based template for pore formation, the improvement comprises...” is a Jepson-type claim limitation; drafting a claim in Jepson format is taken as an implied admission that the subject matter of the preamble is the prior art work of another.

Regarding **claim 4**, the cyclodextrin derivatives of modified Yim et al, exemplified by hexakis(2,3,6-tri-O-acetyl)-alpha-cyclodextrin conforms to the formula 3 of the instant claim.

Regarding **claim 5**, the exemplified hexakis(2,3,6-tri-O-acetyl)-alpha-cyclodextrin of modified Yim et al is a triacetyl-alpha-cyclodextrin.

Regarding **claim 6**, modified Yim et al further teaches examples of solvent for the composition of the invention to include dimethylformamide [0055].

Regarding **claims 7 and 10-12**, though modified Yim et al does not teach the ultra-low dielectric film for a copper interconnect, wherein said ultra-low dielectric film has a maximum porosity of 60% and a minimum dielectric constant of 1.5, the examiner notes

that these are inherent properties of the dielectric film and since all the components of the dielectric film of modified Yim et al fall within the ranges of the components of the claimed ultra-low dielectric film, then the dielectric film of modified Yim et al exhibits claimed maximum porosity and minimum dielectric constant properties.

9. **Claims 1-12** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Ko et al (US 2001/0055891)** in view of **Yim et al (US 2003/0055134)**.

Regarding **claim 1**, Ko et al teaches a dielectric film formed by a low dielectric resin composition comprising (a) organosilane component, which includes at least one compound selected from the group consisting of (a-1) organosilane of the chemical formula 1, (a-2) organic bridged silane of the chemical formula 2; (b) pore-forming component containing decomposable organic molecules by thermal curing with/without irradiation [0026-0031]; Ko et al further teaches that the reaction between the component (a) and the component (b) may take place in the state of the solution or during the state of forming the coating film and further teaches solvent which may be used in the invention to include any agent or mixture of agents which will dissolve the composition to form a homogeneous liquid mixture of the component (a) and (b), examples of which include N,N-dimethyl formamide [0037-0038]. Ko et al further exemplifies a dielectric film formed from a composition that include methyltrimethoxysilane and bistrimethoxysilyl ethane [0049-0051].

The organosilane of the chemical formula 1, exemplified as methyltrimethoxysilane and the organic bridged silane of the chemical formula 2, exemplified as

Art Unit: 1796

bistrimethoxysilylethane of modified Ko et al serve as the polyalkyl silsesquioxane precursor or its copolymer of the instant claim.

Though Ko et al does not teach the ultra-low dielectric film of the instant claim, Ko et al further teaches the advantages of using a dielectric material having a low dielectric constant in semiconductor device manufacture, illustrating that if the dielectric constant of a dielectric material is changed from 4.0 to about 2.5, IC operating speed will be improved by about 20% [0006-0007]; however, the dielectric constant of the dielectric film formed from the dielectric composition of the invention of Ko et al can be as high as 3.3 [0026].

Yim et al teaches thin films having very low dielectric constant ($k \leq 2.50$) formed from a composition comprising thermostable organic or inorganic matrix precursor and thermo-unstable cyclodextrin derivatives [0017]; Yim et al further teaches examples of the thermostable inorganic matrix precursor to include (1) silsesquioxane and (3) a silicate composition wherein the constitution of $\text{RSiO}_{1.5}$ or R_2SiO is organically modified [0018]. Yim et al further teaches the cyclodextrin derivatives having maximum radius of about 1.3-3 angstrom [0046] and specific examples of the cyclodextrin derivatives [0049] and illustrates compositions comprising cyclodextrin derivative having lower dielectric constant than compositions without cyclodextrin derivatives, with the dielectric constant decreasing with an increase in the amount of cyclodextrin derivative incorporated into the composition [see Table 3, 0075].

Since both the inventions of Yim et al and Ko et al are directed to lowering the dielectric constant of films, motivated by the very low dielectric constants of compositions

Art Unit: 1796

comprising cyclodextrin derivatives as taught by Yim et al, one of ordinary skill in the art would have incorporated any of the specific examples of cyclodextrin derivatives of Yim et al, including the acetyl cyclodextrins, into the composition of Ko et al, in order to have a composition, hence a film with very low dielectric constant.

The cyclodextrin derivatives of modified Ko et al, exemplified by the acetyl cyclodextrins serve as the acetylcyclodextrin nanoparticles template of the instant claim.

Though modified Ko et al does not teach an ultra-low dielectric film prepared by coating with an organic-inorganic mixed solution containing in an organic solvent 40-70 vol% of a polyalkyl silsesquioxane precursor or its copolymer as the matrix and 30-60 vol% of acetylcyclodextrin nanoparticles as the template, when faced with a mixture, one of ordinary skill in the art would be motivated by common sense to select a 1:1 ratio, a ratio that falls within the presently claimed amount (50 vol% of polyalkyl silsesquioxane precursor and 50 vol% of acetylcyclodextrin nanoparticles), absent evidence of unexpected or surprising results. Case law holds that having established that this knowledge was in the art, the examiner could then properly rely on a conclusion of obviousness, from common knowledge and common sense of the person of ordinary skill in the art within any specific hint or suggestion in a particular reference.

The dielectric film of modified Ko et al serves as the ultra-low dielectric film of the instant claim.

Though modified Ko et al does not teach "In an ultra-low dielectric film for a copper interconnect..", the examiner notes that this is an intended use limitation; statements in the preamble reciting the purpose or intended use of the claimed invention which do not

Art Unit: 1796

result in a structural difference between the claimed invention and the prior art do not limit the claim and do not distinguish over the prior art apparatus.

Moreover, “In an ultra-low dielectric film for a copper interconnect prepared using an organic or inorganic matrix and a cyclodextrin-based template for pore formation, the improvement comprises...” is a Jepson-type claim limitation; drafting a claim in Jepson format is taken as an implied admission that the subject matter of the preamble is the prior art work of another.

Regarding **claims 2 and 3**, modified Ko et al exemplifies methyltrimethoxysilane and bistrimethoxysilyl ethane as (a-1) and (a-2) respectively [0049-0051].

Regarding **claims 4 and 5**, modified Ko et al further teaches specific examples of the cyclodextrin derivatives to include hexakis(2,3,6-tri-O-acetyl)-alpha-cyclodextrin [see Yim et al, 0049]. Hexakis(2,3,6-tri-O-acetyl)-alpha-cyclodextrin of modified Ko et al is a triacetyl-alpha-cyclodextrin that conforms to the general formula 3 of the instant claim.

Regarding **claim 6**, modified Ko et al teaches examples of solvent used in the invention to include N,N-dimethyl formamide [0037-0038].

Regarding **claims 7-12**, though modified Ko et al does not teach an ultra-low dielectric film for a copper interconnect wherein said ultra-low dielectric film has a maximum porosity of 60% and a minimum dielectric constant of 1.5 of the instant claim, the

Art Unit: 1796

examiner notes that the maximum porosity and dielectric constant of a substance are inherent properties of the substance which depend on the components of the substance; since all the components of the dielectric film of modified Ko et al fall within the ranges of the components of the ultra-low dielectric film of the present invention, then the dielectric film of modified Ko et al exhibits the maximum porosity and dielectric constant that the applicant claims.

Conclusion

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to OLATUNDE S. OJURONGBE whose telephone number is (571)270-3876. The examiner can normally be reached on Monday-Thursday, 7.15am-4.45pm, EST time, Alt Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Randy Gulakowski can be reached on (571)272-1302. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 1796

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

O.S.O.

/Margaret G. Moore/
Primary Examiner, Art Unit 1796

mgm
12/10/08

Application/Control Number: 10/581,165
Art Unit: 1796

Page 13